



RESEARCH AND DEVELOPMENT TECHNICAL REPORT  
ECOM-3001

DEVELOPMENT AND EVALUATION  
OF A LARGE-SCALE SYSTEM  
FOR SELECTIVE DISSEMINATION OF INFORMATION (SDI)

by

D. W. Wixon  
E. M. Housman

August 1968

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UNITED STATES ARMY ELECTRONICS COMMAND • FORT MONMOUTH, N.J.



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D. W. Wixon  
E. M. Housman

STINFO Branch  
Technical Data, Cataloging and Standardization  
Directorate

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UNITED STATES ARMY ELECTRONICS COMMAND  
FORT MONMOUTH, N. J.

### ABSTRACT

This report describes a large-scale computerized system for Selective Dissemination of Information (SDI) developed over the past five years at the U.S. Army Electronics Command to serve its technical personnel. The system, which uses as its document base the current accessions of the Defense Documentation Center, was developed in three phases: an 18-month semiautomated test with 50 subscribers, a fully automated system with about 500 subscribers, and a proposed standard system for Army use. System descriptions include profiling techniques, keyword matching strategies, processing procedures, flow charts, and samples of inputs and outputs. System effectiveness is evaluated in terms of document ordering, relevance of citations, and the impact the system has had on the R&D program as revealed by responses to questionnaires.



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## INTRODUCTION

During the past five years, the U.S. Army Electronics Command developed and tested a large-scale computer system designed to notify its technical personnel of newly published literature in their individual fields of interest. This Selective Dissemination of Information (SDI) system, now serving more than 500 subscribers, is intended to keep scientists, engineers, and project managers continuously aware of the latest technical developments that might affect their work.

The primary product of the ECOM SDI system is a computer-produced booklet called "Selected Abstracts," issued semimonthly to each subscriber. Each booklet contains a special selection of document references selected by the Burroughs-5500 computer as of potential interest to the individual subscriber.

The subscriber indicates his interests to the computer by preparing a list of subject keywords, called his "interest profile." These interest statements, compiled on a master tape, are run in the computer semimonthly against a computer tape containing abstracts of about 2,000 newly published technical documents, each similarly coded with subject keywords. By comparing profile keywords and abstract keywords, the computer selects those abstracts that are within each subscriber's specified interest areas.

The document abstract tape, against which the interest profiles are matched, is provided cost-free to ECOM by the Defense Documentation Center (DDC). The tape represents the most complete collection of newly generated technical reports and articles resulting from the multibillion dollar Department of Defense research, development, test and evaluation program.

A typical Selected Abstracts booklet prepared for a subscriber semimonthly contains about 16 document citations, from which the average subscriber orders about two documents. Copies of requested documents are forwarded to the user on request, usually within 10 days.

The ECOM SDI system was developed in three phases: (1) an 18-month semiautomated test with about 50 subscribers; (2) a fully automated pilot system with subscribership growing from 50 to about 500; and (3) a fully automated standard system for possible Army-wide adoption, incorporating changes and improvements found advisable from pilot test experience.

Among the benefits to be expected from such a system are: reduced time spent by scientists in literature searching, reduced duplicative experimentation, greater application of external scientific achievements, improved technical proficiency, greater current awareness, and increased productivity, all of which contribute to reduced cost of research and development and more rapid development of new military equipment.

Development of such a system at ECOM was undertaken because of increased concern over what is commonly termed the "information explosion." The number of reports and articles being published by the worldwide scientific community has reached the point where the individual scientist often cannot keep up with the literature, even in his narrow field of specialization, without devoting a prohibitive amount of time in library searching. And the situation is rapidly worsening, with expectation that the already heavy publication rate will double in 10 years.



It is generally agreed that the situation requires the marshalling of advanced computer technology to assist the researcher in filtering this flood of new literature for data that can be applied to his project. The SDI system is viewed as one effective method to achieve this end.

According to a recent survey,<sup>1</sup> there are 96 installed SDI systems in this country and abroad, 14 of which are operated by U. S. Government agencies. In the Army, there are three other systems: one at the U. S. Army Biological Laboratory, Fort Detrick, Frederick, Md.; one at the U. S. Army Natick Laboratories, Natick, Mass.; and one at the U. S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

Success of the ECOM system is largely credited to the fact that it is strongly user-oriented, with maximum emphasis on service and convenience. Under this policy ground rule, subscribers are under no obligation to order documents announced to them or to feed back information to the system once they are enrolled. It is a barometer of system acceptance that despite this fact, document ordering is heavy, incidence of subscriber dropout is low, and response to questionnaires is heavy and favorable.

#### PHASE I SYSTEM (SEMI-AUTOMATED PILOT TEST)

In June 1963, ECOM decided that within the Department of Defense there was a ready-made opportunity to exploit the SDI concept, using the current accessions listing provided by the Defense Documentation Center (DDC) in its Technical Abstract Bulletin (TAB). This semimonthly publication includes abstracts of the latest technical reports and articles in all fields of science and technology resulting from the nationwide Defense RDTE effort, and contains a valuable fund of information that had been largely untapped by ECOM technical personnel.

In the TAB, DDC assigns to each document a cluster of keywords describing the document's content from a list of keywords (descriptors) published in the DDC thesaurus.<sup>2</sup> DDC provides, along with the TAB, a complete cross-index to the primary (starred) keywords for each document so that all documents with a certain keyword in a primary capacity can be readily found.

Thus, to provide a primitive test SDI service at ECOM, all that was necessary was to obtain from each subscriber a list of terms from the DDC thesaurus that described his interests and, through clerical procedures, to assemble into booklets the citations that had those terms as starred keywords.

#### Subscribership

A preliminary test in July 1963 with two subscribers was most promising. Two months later, ECOM began an 18-month pilot study with a steadily increasing number of subscribers, beginning with 16 and reaching its peak at 56.

#### Profiling

Profiles were prepared initially by interviewing prospective subscribers, but it was found after a few months that subscribers could effectively select

their own list of keywords from the DDC thesaurus. The interview method was therefore abandoned in favor of self-profiling, with professional assistance provided only on request. The self-profiling system was further refined by preparation of a User Profiling Handbook,<sup>3</sup> which was employed exclusively during the last few months of the Phase I test and through the entire Phase II period to date.

### Selection

As the number of subscribers grew, it became evident that processing would be faster and more economical with the aid of punch card equipment, thus the following semiautomated procedure was established. For each semi-monthly SDI run, the TAB index of starred descriptors was matched clerically against a master alphabetical list of all descriptors appearing in all profiles. A punch card was prepared for each hit, and these cards were processed to provide a list of hits, sorted in sequence with their appearance in the TAB. Each hit citation was cut from the TAB and marked to indicate the code numbers for all subscribers to receive that citation. A proper number of copies were made of each hit citation, and the reproductions were sorted into packets for each subscriber. Each packet was covered with a preaddressed order sheet to form a compact booklet of all hit citations for each subscriber. A sample booklet appears in Fig. 1.

### Evaluation

During the 18-month Phase I test, document ordering was heavy and constant, and subscribers voiced great satisfaction with the service.

The choice of DDC as the document base for the system was advantageous from another point of view: DDC furnished copies of all documents announced in the TAB promptly and without cost. When a subscriber ordered an announced document, a hard copy was provided, usually in about 10 days.

Below are the average volume figures compiled from data during the entire 18-month period.

TABLE I  
TYPICAL SEMIMONTHLY RUN IN THE PHASE I PILOT TEST

Average Number of Subscribers	Average Number of Referrals Per Booklet	Average Number Ordered From Each Booklet	Percent Ordered
35.0	25.5	3.0	11.7

These figures indicate the heavy use that was made of the service. The data are reinforced by the users' evaluation of the hard copies of ordered documents after receipt.

Based on a six-month sample, 29.5% of the ordered documents were evaluated as "of extreme interest," 58% as "of interest," and 12.5% as "of no interest," indicating clearly that scientists could effectively select documents of value from their booklets. In reply to a questionnaire, almost all



1. TO:

GDM (Soled)

2. TO:  
Chief  
Tech Info Div. (-TN)

## SELECTED ABSTRACTS

compiled for:

Julius Soled

Attached is a new group of abstracts selected on the basis of your Technical Interest Profile from the latest DOD document acquisitions.

Please list below the "AD" document numbers of papers you want. We will obtain them for you.

Return this at your earliest convenience. It will be retained for your reference.

1. 412 4
2. 412 8
3. 413 1
4. 413 6
5. 339 C
6. 412 8
7. 411 7

the transition of at-  
the devel-  
were crown-  
InP lasers  
those of GaAs  
the moment which  
r laser applica-  
al and optical prop-  
GaAs diodes in which  
the p-side near the  
and the predominant depen-  
tically to increase from the  
nese diodes was electric-  
exhibit a negative resistance  
characteristics have been observed.

Fig. 1. "Selected Abstracts" Booklet (Phase I System).

subscribers rated the system highly, and asked that it be continued. The average relevance of citations reported by the subscribers was 44%. (The lower ordering figure is explained by the fact that subscribers usually ordered only those relevant citations of immediate interest, others were merely noted or filed, or in many cases the abstract sufficed to brief the subscriber on the report.)

A system modeled on the Phase I pilot test could well be adopted by a small laboratory with less than 100 potential subscribers. However, to serve a large scientific community such as ECOM with 2,700 technical personnel, more complete automation was required.

## PHASE II SYSTEM (FULLY COMPUTERIZED SERVICE)

Encouraged by the reaction to the Phase I test, it was decided to fully automate the system on ECOM's Burroughs-5500 computer, using as the document input the computer tape used by DDC to produce the TAB. This would eliminate almost all the clerical chores involved in preparing and distributing the Selected Abstract notices and would enable larger subscribership. Approval to inaugurate Phase II was granted by ECOM headquarters in November 1965. After being briefed on the proposed system, DDC agreed to supply the required computer tapes on a regular basis.

### Computer Program

A COBOL computer program was prepared by the ECOM Computation Agency, and the system became fully operable in September 1966. A simplified system flow chart (Fig. 2) shows the major inputs and outputs. The inputs are (1) the semimonthly DDC tape containing about 2,000 new citations indexed and abstracted; (2) a tape containing all subscriber profiles; (3) punch cards for updating the profile file; and (4) a tape containing all keywords in the DDC thesaurus to validate the profile file. Complete flow charts for the system appear in the Appendix, along with run descriptions.

The Phase II system performs automatically all the clerical procedures of the Phase I system even to printing the Selected Abstract booklet for each subscriber; however, bursting, stapling and mailing are clerical functions. The computer also prepares the preaddressed cover sheet used to route the booklet to the user and, in turn, to serve as a document order form. A sample cover sheet and an abstract printout appear in Figures 3 and 4.

Also produced are a series of statistical reports for system evaluation: one listing all the hits for each subscriber by keyword (Fig. 5); one giving the number of documents referred to each subscriber and a cumulative tally (Fig. 6); one listing the hits alphabetically by keyword (Fig. 7); one listing all current profiles (Fig. 8); and one listing the users for each keyword in the profile file (Fig. 9).

### Subscribership

In preparing for subscribership increase, the SDI Profiling Handbook<sup>3</sup> was printed in large numbers, and a promotional brochure was issued. Subscribership was boosted in stages from 50 to 100, to 250, to 400, and presently stands at 520. Of these subscribers, about 100 are from military agencies outside of ECOM, who requested enrollment on a test basis after becoming aware of the system either in the New York Times,<sup>4</sup> or in the trade magazines.



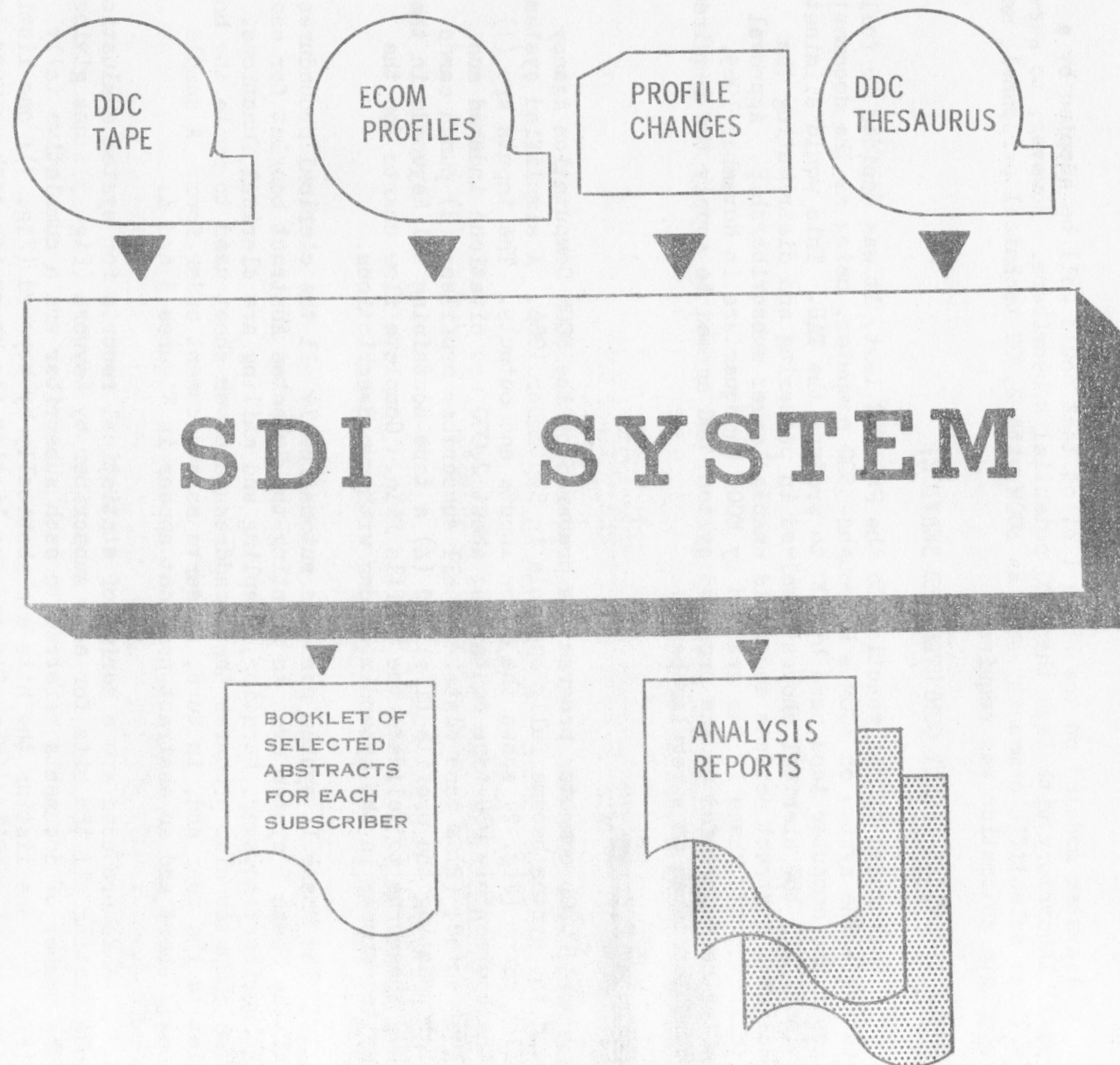


Fig. 2. Simplified System Flow Chart (Phase II System).

1. TO: ROSS, RAYMOND  
XL-E

2. TO: TECH INFO DIV  
AMSEL-IO-T  
HEXAGON

SDI

SELECTED ABSTRACTS

TO ORDER HARDCOPIES OF ANY OF THE DOCUMENTS ANNOUNCED IN THIS  
BOOKLET MERELY LIST THEIR "AD" NUMBERS BELOW AND RETURN THIS COVER  
SHEET TO TECH INFO DIV.

AD-

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Fig. 3. Pre-addressed Cover Sheet for "Selected Abstracts" Booklet.



USER NAME:  
DATE:

ROSS, RAYMOND  
12-19-67

DOCUMENT NUMBER: AD-659 801

A FACILITY FOR THE STUDY OF NEUTRON MODERATION AT CRYOGENIC  
TEMPERATURES IN A LIGHT WATER POOL NUCLEAR REACTOR.

BY:

ANTAL, JOHN J., LANDRY, ARTHUR F., IWARNA, ALBERT A., J

ARMY MATERIALS AND MECHANICS RESEARCH CENTER WATERTOWN MASS

TECHNICAL REPT.,

DESCRIPTORS:

(\*REACTOR MODERATORS, \*CRYOGENICS), (\*SOLIDIFIED GASES, RE-  
ACTOR MODERATORS), NEUTRON BEAMS, SOURCES, TEST FACILITIES,  
LIGHT WATER REACTORS, METHANE

ABSTRACT:

HOLDING A SMALL AMOUNT OF MODERATOR MATERIAL AT VERY LOW TEMPERATURES IN A NUCLEAR REACTOR PROVIDES A VERY USEFUL SOURCE FOR THE PRODUCTION OF HIGH-INTENSITY LOW-ENERGY NEUTRON BEAMS, WHICH BEAMS ARE EMPLOYED IN STUDIES CONCERNING THE SOLID AND LIQUID STRUCTURAL STATE OF MATERIALS. SINCE VERY LITTLE IS KNOWN OF THE FACTORS AFFECTING THE EFFICIENCY OF SUCH SOURCES, AN EXPERIMENTAL FACILITY HAS BEEN PLACED IN OPERATION TO STUDY VARIOUS PARAMETERS, PARTICULARLY THE SPATIAL DISTRIBUTION OF THE COLD MODERATOR. THE FACILITY AND ITS DESIGN AND OPERATION ARE DESCRIBED, WITH EMPHASIS ON PROBLEMS CREATED BY THE ADDITION OF A NUCLEAR RADIATION FIELD TO THE CRYOGENIC ENVIRONMENT. THE RESULTS OF INITIAL STUDIES ON THE MODERATION OF NEUTRONS BY SOLID METHANE AT 84K ARE PRESENTED. (AUTHOR)

Fig. 4. Abstract Printout.

USER NUMBER	DESCRIPTOR	NEG USE	POS DESC.		
159-32-2065	ACOUSTICS		2		
	BANDWIDTH		1		
	DATA-TRANSMISSION-SYSTEMS		2		
	INTELLIGIBILITY				1
	PSYCHOACOUSTICS		1		
	SOUND				
	SPEECH		2		
	SPEECH-RECOGNITION		1		
165-01-6574	SPEECH-TRANSMISSION				
	VOICE-COMMUNICATION-SYSTEMS		1		
	SUB-TOTAL	0 +	10	=	10
	BARGAINING		1		
	CIVILIAN-PERSONNEL				
	COSTS		2		
	ECONOMICS		6		
	MEMORY		1		
165-12-0379	MONEY				
	WAGES				
	SUB-TOTAL	0 +	10	=	10
	AIR-TRAFFIC-CONTROL-SYSTEMS				
	DIRECTION-FINDING		3		
	ELECTRONIC-RECORDING-SYSTEMS				
	INSTRUMENTATION		1		
	INTEGRATED-CIRCUITS		8		
	INTERFERENCE		2		
	MAGNETIC-TAPE				
	MICROMINIATURIZATION(ELECTRONICS)		3		
	MILITARY-TACTICS				
	RADIO-JAMMING				
	RADIO-NAVIGATION		1		
	RELIABILITY(ELECTRONICS)		4		
	SINGLE-SIDE-BAND-COMMUNICATION-SYSTEMS				
	SPEECH-RECOGNITION		1		
	STRAIN-GAGES				
	TELE-METER-SYSTEMS		1		
	TEST-METHODS		2		
	THATLAND				
	THERMOCOUPLES		1		
	TRANSDUCERS		3		
	SUB-TOTAL	0 +	30	=	30

Fig. 5. Hits for Each Subscriber by Keyword.

DATE: 02-24-68

## STIMED STATISTICAL ANALYSIS # 2

PAGE: 16

USER NAME	USER NUMBER	NO. ABS.	NO. DOC. ORDERED	Y.T.D. NO. ABS.	NO. DOC. ORDERED Y.T.D.
PREUSSE, JOHN W.	159-32-2065	10		20	0
JACOBSEN, EDWARD T.	165-01-6574	8		18	0
HAW, JOHN J.	165-12-0379	32		61	0
BROWNE, C. J. (PHILADELPHIA)	166-07-0220	0		15	0
MOCHREITER, JOSEPH J.	167-16-7439	41		93	0
MILLER, ROBERT J.	167-22-5480	25		53	0
BRUSH, GEORGE E.	168-10-4912	29		45	0
BAKER, EDWARD J.	168-26-5543	15		46	0
MEE, EDMUND J.	169-16-5133	0		7	0
THATCHER, JESSE B.	170-09-1832	7		19	0
SIOLIN, PIERCE	171-01-6526	33		71	0
MC GOWAN, JOSEPH W.	171-30-2089	22		47	0
KLINE, JAMES C.	175-36-9841	7		19	0
ANKNER, FRANK G.	179-24-8487	52		94	0
MAJOR, PAUL A.	179-32-6297	36		61	0
HABER, GEORGE	182-28-9885	23		44	0
BERTOLINI, RICHARD	182-32-3086	52		124	0
BILLE, WILLIAM B.	182-32-8096	28		66	0
BERGEY, JAMES S.	184-05-9642	3		12	0
OLSEN, WILLIAM A.	184-26-1288	9		28	0
KOENIG, W. A. (PHILADELPHIA)	185-03-7921	20		77	0
LOMICKA, CHARLES R.	188-32-1084	24		64	0

Fig. 6. Number of Abstracts Referred to Each Subscriber.

USER NAME AND KEYWORDS			
USER NR	NAME KEYWORDS	PHONE NR	USER MAIL SYM NR ADS SENT NR DOC ORDERED
043204108	RICCIARDI, BERNARD V. AIRCRAFT-ANTENNAS DIGITAL-TO-ANALOG-CONVERTERS INFORMATION-THEORY RADIO-TRANSMITTERS SEMICONDUCTOR-DEVICES TRANSISTORS WALKIE-TALKIES	52148	VL-C 00017 DATA-TRANSMISSION-SYSTEMS DIODES RADIO-RECEIVERS RELIABILITY(ELECTRONICS) TRANSISTOR-AMPLIFIERS TRANSMITTER-RECEIVERS
046202953	GLEASON, PHILLIP AIR-TRAFFIC COMMAND-CONTROL-SYSTEMS FLIGHT-INSTRUMENTS IMPEDANCE-MATCHING SEMICONDUCTORS VOICE-COMMUNICATION-SYSTEMS	52568	SELAC-I 00042 ANTENNA-RADIATION-PATTERNS COMMUNICATION-SYSTEMS FREQUENCY-MODULATION LASERS STANDING-WAVE-RATIOS
047265176	COULOPOULOS, JAMES FACSIMILE-COMMUNICATION-SYSTEMS FACSIMILE-RECORDING-SYSTEMS FIBER-OPTICS	51225	NL-E-2 FACSIMILE-EQUIPMENT FACSIMILE-TRANSMISSION
049122098	FLYNN-OBSTACLE AVOID. TEAM ALL-WEATHER-AVIATION ARMY-AIRCRAFT CIRCUITS ELECTRONIC-SCANNERS INFRARED-DETECTORS IRASERS LIGHT-TRANSMISSION MICROWAVE-OSCILLATORS UPDAR POLARIZATION PULSE-COMPRESSION RADAR-REFLECTIONS	51903	VL-E 00038 ARMED-FORCES-RESEARCH AVIATION-ACCIDENTS CIVIL-AVIATION ELECTROOPTICS INFRARED-OPTICAL-SYSTEMS LASERS MICROWAVE-AMPLIFIERS MILLIMETER-WAVES OPTICAL-SCANNING PROPAGATION RADAR TERRAIN-AVOIDANCE
049303454	GLORIOSO, ROBERT M. ADAPTIVE-COMMUNICATION-SYSTEMS BIONICS CYBERNETICS LEARNING-MACHINES MAN-MACHINE-SYSTEMS READING-MACHINES	52987	NL-P-1 00026 ARTIFICIAL-INTELLIGENCE CHARACTER-RECOGNITION INFORMATION-THEORY MACHINE-TRANSLATION PATTERN-RECOGNITION SPEECH-RECOGNITION
050037878	ANICK, GEORGE ANTENNA-APERTURES DATA-PROCESSING-SYSTEMS DIGITAL-COMPUTERS ITERATIVE-METHODS PROBABILITY RADAR SIDE-LOOKING-RADAR	61325	NL-CT-R 00062 CODING DATA-STORAGE-SYSTEMS INFORMATION-THEORY NETWORKS PULSE-COMPRESSION RANGE-FINDING STOCHASTIC-PROCESSES
050203306	LEVY, MARILYN PHOTOCHEMISTRY PHOTOGRAPHIC-CHEMICALS	52309	NL-CT-O 00002 PHOTOCHROMISM PHOTOGRAPHIC-CONTRAST

Fig. 7 Current Profiles.



DATE 02-24-68

## STINFO STATISTICAL REPORT # 3

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DESCRIPTOR	DOCUMENT NUMBER	USER NUMBER	NEG USE	POS USE	NEG POS TOTALS
CERAMIC-MATERIALS	AD-824-783	118-24-0689		*	
		147-20-4320		*	
	AD-824-621	171-30-2089			
		154-18-3403			
		118-24-0689			
		147-20-4320			
		080-18-2291			
		151-24-1725			
	SUB-TOTAL		0 +	24 *	24
CERMETS	AD-663-153	054-05-6262		*	
		109-22-9966		*	
	AD-663-355	054-05-6262		*	
		054-05-6262		*	
		109-22-9966		*	
		109-22-9966		*	
	AD-824-481	054-05-6262		*	
		109-22-9966		*	
	SUB-TOTAL		0 +	6 *	6
CESIUM	AD-824-343	022-28-5561			
	AD-824-696	022-28-5561			
	SUB-TOTAL		0 +	0 *	0
CHARGED-PARTICLES	AD-662-905	000-00-0403			
	AD-662-906	000-00-0403			
	AD-662-907	000-00-0403			
	AD-662-915	000-00-0403			
	AD-663-039	000-00-0403			
	AD-663-234	000-00-0403			
	SUB-TOTAL		0 +	0 *	0

Fig. 8 Hits Alphabetically by Keyword.

## KEYWORDS AND USERS

## KEYWORDS

## USERS

## ADJUSTMENT(PSYCHOLOGY)

000000501 000001407

## ADSORPTION

000000412 000000415 051128973

## ADVANCED-PLANNING

000000801 094010125 119012414

## ADVANCED-WEAPONS

526444977

## AERIAL-CAMERAS

138147312 145303817 156030646

## AERIAL-MINES

000000410

## AERIAL-PHOTOGRAPHS

156030646

## AERIAL-PHOTOGRAPHY

000002007 145303817 146141384 154037576 156030646 162328096

## AERIAL-RECONNAISSANCE

000000304 000000701 053187661 068079306 138147312 145240730 154037576 156280193 233287254 342305238

559545644 578327384

## AERIAL-TARGETS

138147312 145240730 145303817

## AERIAL-WARFARE

416204438

Fig. 9. Users for each Keyword.

Among these are: Edgewood Arsenal, Aberdeen Proving Ground, Fort Detrick, Fort Totten, West Point, the Corps of Engineers, Sandia Air Force Base, and the Joint Chiefs of Staff. These enrollees were accepted to test the applicability of the system to external agencies in preparation for the Phase III program.

The target ECOM enrollment for FY-69 is 1,000, which is considered the saturation point for ECOM with its 2,700 technical personnel. Many subscribers who have common interests share their Selected Abstract notices with co-workers.

The subscriber dropout rate has been extremely low. During the entire five-year period, only 40 users discontinued the service and this was mostly due to retirement or job changes. Twelve of the original 16 subscribers are still active SDI users.

Enrollees consist mostly of scientists, engineers, and technicians, but also include managers, military personnel, instructors, project leaders, and systems analysts. Subject coverage is broad. Of the 7,145 descriptors listed in the SDI Profiling Handbook, 2,843 were selected as profile terms by ECOM subscribers.

### Profiling

All new subscribers during the Phase II system prepared their own profiles by referring to the User Profiling Handbook.<sup>3</sup> A profile analyst was available for assistance, but was rarely called upon. His primary function was to compare the profile keywords submitted by the subscriber with the narrative statement of the user's interests and recommend changes where they seemed required. He also reviewed in detail with the subscriber profiles that retrieved an excessive number of citations, or profiles that were producing many irrelevant citations. To correct these citations, the analyst could use the improved capability provided by the Phase II system to employ "negative keywords" in the profile to reduce unwanted citations.

In general, subscribers had little difficulty locating the appropriate terms for their profile from the profiling handbook, which was specially compiled from keyword data provided by DDC. The handbook lists keywords both alphabetically and by COSATI\* subject fields and groups. A typical subscriber takes about 20 minutes to complete his profile, which on the average consists of 15 terms.

### Selection

Below is a sample document citation as it appears in the TAB, and as it is coded onto the computer tape supplied semi-monthly by DDC for processing in the ECOM SDI system.

---

\*Committee on Scientific and Technical Information of the Federal Council on Science and Technology.

AD-653 060 Fld. 20/5  
CFSTI Prices: HC \$3.00 MF \$0.65  
MINNESOTA UNIV MINNEAPOLIS DEPT  
OF ELECTRICAL ENGINEERING  
ACTIVE DISTORTION DURING RUBY LASER  
ACTION.  
Technical rept.,  
by Mylan Radulovich and R. J. Collins. Apr 67,  
58p. Rept. no. TR-5  
Contract Nogr-710 (61), Proj. NR-015-704  
Unclassified report

Descriptors: (\*Lasers, Distortion), (\*Ruby,  
Thermal stresses), Pumping (Optical), Ther-  
mal properties, Optical properties, Thermal  
conductivity, Interferometers, Heating, Ther-  
mal expansion, Refractive index

Ruby laser rods were studied with respect to ther-  
mal distortions induced by the excitation pump  
flash. Nonuniform temperature distributions cause  
optical distortions and prevent the laser beam from  
realizing its minimum theoretical width (diffraction  
limit). These variations result from the radial distri-  
bution of absorbed energy. The radial gradients  
produce changes in the index of refraction and opti-  
cal path length which lead to a lens type behavior  
by the ruby rod. More uniform pumping would re-  
duce the temperature distributions and conse-  
quently diminish this lens effect. (Author)

#### Fig. 10 Sample Citation

Approximately 2,000 citations of this type appear in each semimonthly tape. In addition to the normal bibliographic data and abstract, the citation contains a cluster of descriptors (keywords) assigned by DDC indexers. Note also that two of the 12 terms are preceded by an asterisk, indicating that these are topics of major concern in the document. The other terms act as modifiers, or indicate concepts of lesser importance in the document.

Since both the keywords assigned to each document and the keywords in each subscriber's interest profile are selected from the same thesaurus, a definite direct match between keywords on the two files is possible.

In the Phase II system, all subscribers who have one of the starred terms (LASERS or RUBY) as one of their profile keywords would be sent the above citation, except if their profile contained as a negatively coded term one of the other terms assigned to the document (for instance REFRACTIVE INDEX).

A sample profile that would retrieve this citation is shown below:

Brightness  
Infrared-Images  
Infrared-Optical-Materials  
Lasers  
Light-Pulses  
Optical-Equipment  
Optical-Scanning  
Photographic-Recording-Media  
Resolution  
Ultraviolet-Optical-Materials  
Fiber-Optics  
Infrared-Lamps  
Infrared-Optical-Systems  
Lenses  
Luminescence  
Optical-Images  
Photographic-Emulsions  
Photosensitivity



The introduction of negative descriptors in the Phase II system improved the selectivity of the matching strategy used in Phase I. For example, a subscriber who has the term PROPAGATION as a keyword but is not interested in the propagation of mechanical waves could add the negative descriptors ACOUSTICS and SOUND to eliminate the unwanted citations.

## Evaluation

### 1. Document Ordering

Detailed statistics were recorded on the number of documents referred to each subscriber and the corresponding number ordered. Summary data are presented for the most recent 15 runs (see Tables II and III).

The heavy ordering volume is an indicator of system acceptance and utility. Note that on the average, 12.5% of the citations sent to subscribers were ordered. (The overall range was 9.5% to 20.9%) These figures are typical of the ordering response during the entire five-year period. Note also that starred columns in Table II tend to have higher ordering percentages because the DDC tapes for those runs contained only unclassified-unlimited citations. When classified citations are included, the percentage drops several points, probably because of difficulties in handling and storage.

An analysis of the ordering habits of subscribers for five runs indicates:

(a) 40% are steady users; i.e., documents were ordered from all five runs or from four out of five runs.

(b) 17% are moderate users; i.e., documents were ordered from three out of five runs.

(c) 34% are light users; i.e., documents were ordered from only one or two of five runs.

(d) 11% did not order at all. They were contacted for possible profile modification.

During these five runs, 56% of the Selected Abstract booklets resulted in at least one order. This performance is considered satisfactory, although it could be considerably improved with a more active program to troubleshoot profiles of subscribers who order infrequently.

### 2. Questionnaire

It was evident that the actual relevance of citations was higher than the 12.5% ordering figure. Documents of interest were not ordered for instance, if the document had already been seen, if the subscriber was already familiar with the work, if the abstract sufficed for the present, if the subscriber's reading load was great, or if the document did not have an immediate bearing on his work.

To get a better picture of subscriber reaction to the service, a questionnaire was sent out along with the Selected Abstract booklets to 118 subscribers who had been enrolled for at least four runs. Ninety-six

questionnaires were returned completed. Summary data on responses to significant questions appear below.

Q: Are you receiving too many citations in your Selected Abstract notices?

A: Yes 11%; No 89%.

Q: What percent of the citations in the attached printout is pertinent to your interests?

A: Average of figures stated was 39.7%.

Q: Is this a typical percentage?

A: Yes 68%; No 22%; No answer 10%.

Q: If not, please estimate typical percentage of pertinent documents on an overall basis.

A: Some stated higher percentages, some lower percentages than in previous question, producing a corrected relevance figure of 40.2%.

Q: In general, do you think the percent of relevant documents is satisfactory?

A: Yes 92%, No 5%; No answer 3%.

Q: Are you receiving ordered documents promptly?

A: Yes 95%; No 2%; No answer 3%.

Q: Are reproductions satisfactorily legible?

A: Yes 95%; No 4%; No answer 1%.

Q: Please indicate below the effect this service has had on your work. Check appropriate items.

A: 89% Revealed valuable documents that probably would not have been discovered by subscriber.  
69% Saved time in literature searching.  
34% Revealed other persons working in area who later provided information of value.  
28% Affected technical decisions in work area.  
27% Increased productivity.  
20% Revealed duplication of effort.  
20% Shortened time required to complete a particular task.  
14% Indicated some anticipated work was unnecessary.  
4% Changed course of work.  
3% No benefit.  
0% Affected choice of contractor.

Q: What is your general reaction to the service?

A: Narrative comments were rated as follows:  
Excellent 49%; Good 33%; Moderate 7%; Unfavorable 1%; No comment 10%.

Q: Do you wish to be dropped as a subscriber?

A: Yes 3%; No 97%.

Two items are of particular significance: the answers in regard to citation relevance and to effect on the individual's work.

3. Relevance. Since in the ECOM system subscribers are not required to feed back relevance evaluations for each citation, an indication of overall relevance was sought in the first five questions. Relevance is about 40%, and subscribers are generally satisfied with this relevance.

Table II -- Document Ordering for Latest 15 Runs.

RUN NUMBER	1*	2*	3*	4	5	6	7	8	9*	10*	11*	12	13	14	15	MEAN
NUMBER OF SUBSCRIBERS	119	119	125	135	212	212	212	385	386	386	390	400	410	455	473	265
DOCUMENTS REFERRED	988	1464	1324	2951	4910	3754	5258	3392	4392	3999	4641	9045	8816	8462	9442	4856
DOCUMENTS ORDERED	178	268	277	430	522	544	678	322	587	564	675	1102	963	879	1060	606
PERCENT ORDERED	18.0	18.3	20.9	14.6	11.2	14.5	12.9	9.5	13.4	14.1	14.5	12.2	10.9	10.4	11.2	12.5

\*DDC tape contained only unclassified unlimited citations

Table III -- Cumulated Data for Latest 15 Runs.

GRAND TOTAL REFERRED	72,838
GRAND TOTAL ORDERED	9,088
OVERALL PERCENT ORDERED	12.5
AVERAGE CITATIONS PER BOOKLET	16.5
AVERAGE ORDERED PER BOOKLET	2.1

4. Effect on Work. The responses to question 8 clearly indicate that the service is having a significant impact on the R&D program in terms of awareness of duplication, shortened time required to complete a particular task, reduced time in literature searching, effect on technical decisions, and altering of course of work. The percentages for many of the items were much higher than expected.

Those who checked the item "Saved time in literature searching" were asked to estimate the number of hours saved. Of those who checked this item, the average figure given was a significant 3.4 hours per week.

It would be valuable for other SDI systems to obtain additional data in the area of work impact. It is expected that the results will be similar. Such results present a powerful argument to management for adoption or expansion of SDI services in an R&D community, probably more so than relevance figures.

#### 5. Operating Costs

The total cost for operating the system, based on the cost for one typical run with 500 subscribers, is \$1,229 per run, or \$2.45 per subscriber. Translated to annual figures, the system costs \$29,496 per year, or about \$58 per subscriber.

The largest cost item is \$934 per run for computer processing. This estimate is based on operation on a Burroughs-5500 computer owned by ECOM, with costs prorated to the computer run of many jobs simultaneously.

The amount of actual computer process time was 4.4 hours, with an additional 5.9 hours for printing Selected Abstract notices from backup tapes.

The figures break down as follows:

Computer Processing	\$727.00
Backup Printing	177.00
Keypunching	30.00
Paper and Supplies	175.00
Bursting and Stapling	20.00
Processing Document Orders	50.00
Profiling and Administration	<u>50.00</u>
Total	\$1,229.00

The low operating cost of the ECOM SDI system is attributable to the fact that some of the high-cost items inherent in many other systems are avoided, primarily because of ECOM's use of DDC as a document data base. As part of its normal operations, DDC performs the costly functions of document acquisition, document storage, abstracting, indexing, and keypunching citations.

#### PHASE III SYSTEM (DEVELOPMENT OF STANDARD ARMY SYSTEM)

In September 1964, ECOM suggested that SDI be enrolled in the planned National ADP Program for AMC Logistics Management (NAPALM). This Army Materiel Command (AMC) program is an effort to establish a bank of standard



computer programs in the logistics area for use by all AMC installations, and to emplace standard compatible computer equipment at all installations.

ECOM was assigned subproponency for SDI under NAPALM in February 1965, and a preliminary specification for a standard SDI system<sup>5</sup> was developed. This specification was later updated, based on experience with the operational Phase II system at ECOM.<sup>6</sup>

In December 1967, a complete reevaluation of the Phase II system resulted in development of a new detailed program specification. The computer programs to implement this specification comprise the Phase III system now being programmed and debugged prior to NAPALM implementation in 1969.

### Major Improvements

The new system is basically modeled on the Phase II system, but the operational procedure is considerably streamlined by combining programs and using random access disk storage. In addition, the following new features are added:

(1) Full boolean strategy has been incorporated to increase relevance and permit processing of document files other than DDC's. Under this selection system, a subscriber can express each of his interest areas as a cluster of logically related keywords. By appropriate coding of his keywords, for instance, he can say in effect, "I am interested in all documents that are indexed with either term A or term B, but only if term C or D or E is also present; moreover, if term G or H or I is present, I am not interested in the document." The computer will then select for that subscriber only those documents whose keyword clusters have the appropriate combination of keywords.

(2) The computer automatically produces for each subscriber semi-annually a profile performance summary, which reports on the activity of each keyword during the period so that the subscriber can make appropriate changes. A similar report is automatically produced when a subscriber fails to order documents, or if his profile is producing an excessive number of citations.

(3) The Selected Abstracts notice has been re-formatted for increased readability. Side-by-side printing of two abstracts at once will cut printing time in half and significantly reduce the cost of paper.

(4) Automatic security controls are incorporated to notify the system immediately when the security status of a subscriber changes, and to prevent ordering of a classified document for an unauthorized individual.

A simplified system flow chart for the Phase III system appears in Figures 11a and 11b.

### Automatic Profile Review

Item (2) above, because of its unique approach, deserves special mention. The subscriber's interest profile is not a stable thing. Continual modification is required to correct errors or misjudgments in selecting keywords, and to reflect changes in the subscriber's interests over a period of time. Since subscribers cannot be depended upon to take the initiative in changing their profiles, it becomes incumbent upon the SDI system to provide for systematic updating of profile keywords.

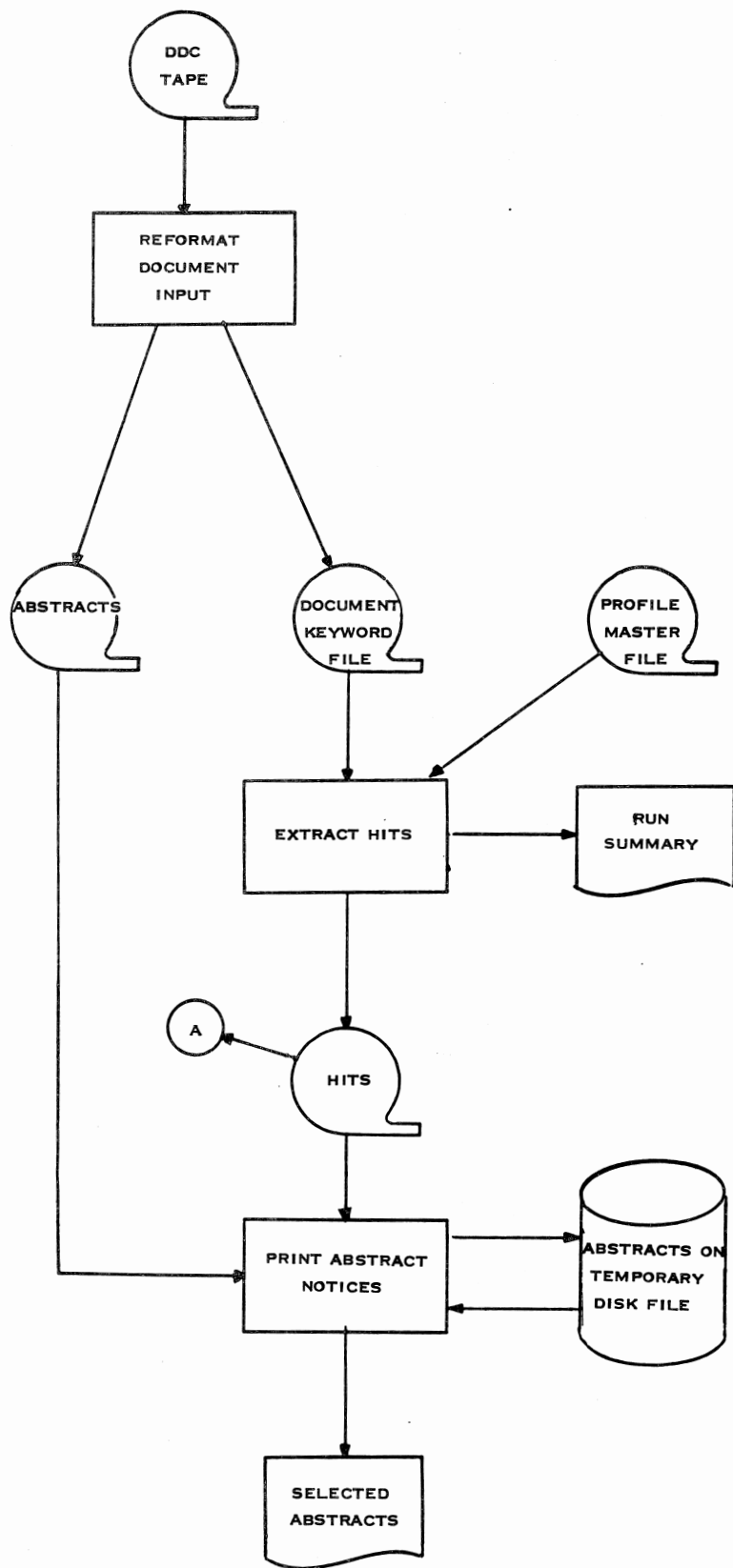


Fig. 11a. Flow Chart for Phase III System, Part I

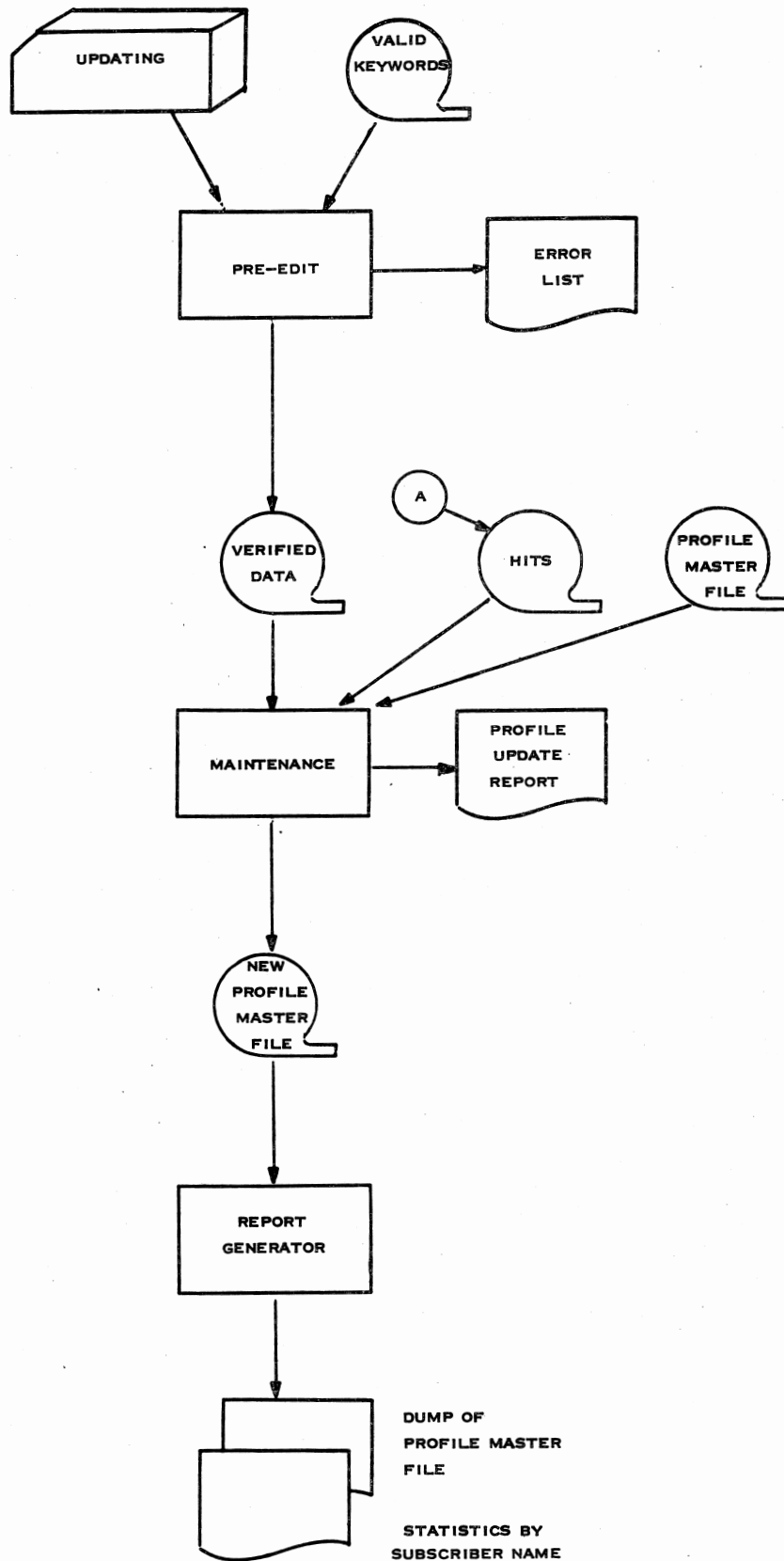


Fig. 11b. Flow Chart for Phase III System, Part 2

The Phase III computer-assisted profile updating system is based on the assumption that the subscriber himself is in the best position to refine his profile, and can perform the task effectively if provided with the proper data. Direct modification of profiles by users has the additional psychological advantage of letting the subscriber feel the system is directly responsive to his will. To this end, the system generates semiannually a profile report to each subscriber. It lists his profile terms, each one annotated with the number of documents referred and ordered under that keyword.

The referred-to-ordered ratio for each term gives the subscriber a precise indication of the effectiveness of each term in his profile, and enables him to spot unfruitful or erroneous keywords. The report is designed so that changes can be made easily. Penciled-in changes can be keypunched directly from the form. Full instructions on how to make changes are provided with the report, and each report is accompanied by a User Profile Handbook.

These profile review reports are automatically generated for one sixth of the subscribers each month, thus providing for semiannual profile evaluation for all subscribers on a phased basis. In addition, reports are to be printed out for subscribers who have not ordered any document for three months, for those whose profile is retrieving more than 100 citations a month, and for those who have changed jobs.

### Microfiche Ordering

In May 1968, DDC announced that effective 1 July 1968, hard copy of announced documents would no longer be provided free of cost, but at a charge of three dollars per copy; however, microfiche would be furnished free. Since the SDI system results in about 20,000 document orders a year, continued ordering of hard copy could become prohibitively costly.

The microfiche shown in Fig. 12 is a 4- by 5 3/4-inch sheet of film containing 60 report pages that can be read on a special viewer to enlarge the page image. To encourage the use of microfiche, ECOM has purchased microfiche reader-printers, which make photocopy of a projected page in six seconds, and also portable readers (without the printing capability). This equipment is placed strategically throughout the agency for use of SDI subscribers.

Present plans are to order only microfiche for SDI users on the initial order, and honor orders for hard copy only after the subscriber has read the microfiche and determines he needs a hard copy of the document. The Phase III system has built-in provisions to implement this plan.

### FUTURE PLANS

The Phase III system is presently being programmed for the Burroughs-5500 or IBM-360 NAPALM computer, and should be fully operational in January 1969. The proposed system will then be tested and coordinated with potential user installations.

One of the future requirements envisioned is addition of pre-edit programs so that files other than DDC's can be input to the system. Some of the abstract files available on tape include those produced by Chemical Abstracts, Index Medicus, Engineering Index, the Institute for Scientific Information, and Pandex. The Phase III system has been designed so that it will be a relatively simple matter to process these other inputs, if required.



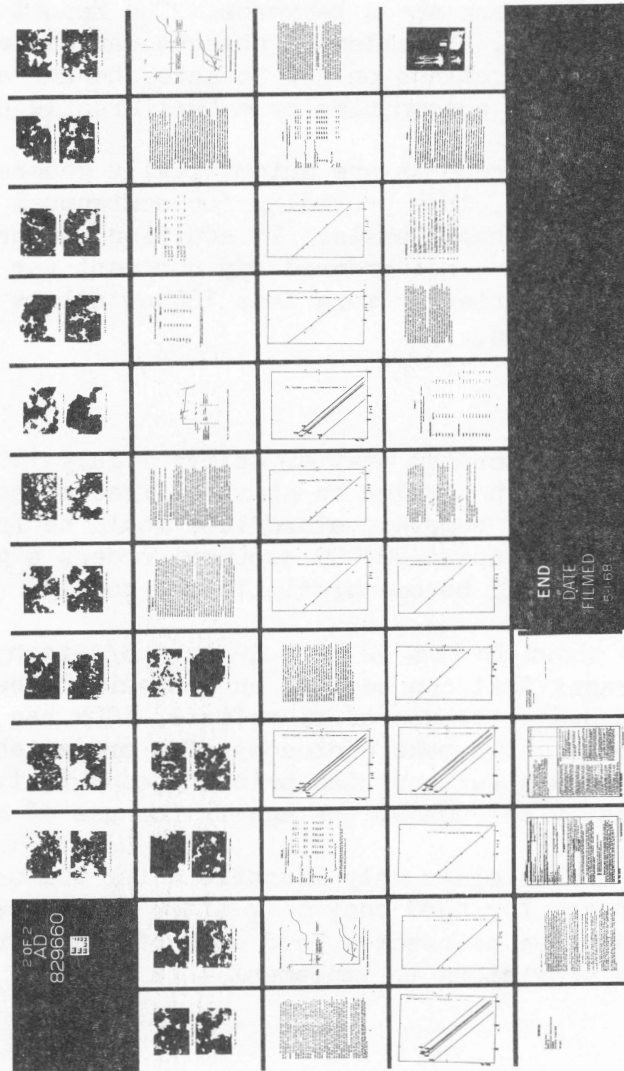


Fig. 12 Sample Microfiche.

## CONCLUSIONS AND RECOMMENDATIONS

The SDI system described has proved notably effective in serving the information needs of ECOM and other Army technical personnel, by notifying them regularly of new documents published in their fields of interest. Response of subscribers has been enthusiastic as reflected in the results of questionnaires, ordering volume, and steady growth of enrollment.

The Phase I semiautomated test established the desirability of such a service at ECOM. The Phase II pilot operation, besides showing that the service can be effectively and economically implemented by computer, formed the basis for development of the improved Phase III system.

Use of the preprocessed current accessions tape of DDC as the document base for an SDI system offers advantages of breadth of coverage, low key-punching load, availability of announced documents, and ease of effective keyword matching.

The system has had a significant impact on the RDTE program at ECOM in terms of reduced duplication of effort, reduced time spent by scientists in library searching, redirection of technical effort, and increased productivity.

As a concrete example of the potential for cost savings implicit in SDI, a subscriber recently reported a saving of \$42,000 and 750 man-hours as a result of one item of information provided.

It is recommended that military R&D activities consider the establishment of an SDI system, such as the one described, to help their technical personnel cope with the information explosion and more effectively apply the results of external scientific work.

## REFERENCES

1. T. R. Savage, "SDI Bibliography-1," Share Research Technical Publication STRP 1095, 15 February 1968.
2. Defense Documentation Center, "Descriptor Hierarchies," Revised May 1965.
3. U. S. Army Electronics Command, SDI Profiling Handbook.
4. Richard D. Lyons, "Computers to Aid Army's Scientists in Research," The New York Times, June 2, 1967.
5. U. S. Army Materiel Command, "NAPALM Specifications, Scientific and Technical Information," Vol. XXII, Part 2, Section 15, Undated.
6. U. S. Army Electronics Command, "Selective Dissemination of Information, System Design Package for Function L-27," April 1967, and Addendum I, December 1967.

## APPENDIX

### RUN DESCRIPTIONS FOR PHASE II PROGRAM

#### ROUTINE I: TAPE CONVERSION (See Fig. A-1)

These programs (STNCON and STN000) reformat the semimonthly DDC document accession tape and create two intermediate tapes: A02, which contains all keywords on the tape and their associated document numbers, and A01, which contains the full document citations.

#### ROUTINE II: SELECTION OF DOCUMENTS FOR EACH USER (See Fig. A-2)

This set of programs (STN001 through STN006) makes the decision on which documents are to be referred to each subscriber and prepares an addressed booklet of selected citations for each subscriber.

STN001 sorts the document keywords into alphabetical order for batch processing.

STN002 records every match between a document and a profile keyword.

STN003 selects from all the hits only those that matched on starred document keywords, eliminates duplicate hits for a subscriber, and rejects citations which hit on a negative descriptor.

STN004 writes out a full document citation for each retrieval.

STN005 sorts these retrievals into subscriber number order in preparation for printing.

STN006 prepares an addressed cover sheet for each booklet, and prints out the full citations, including abstract if present, for all retrieved citations for each subscriber.

#### ROUTINE III: STATISTICAL REPORTS (See Fig. A-3)

These programs (STN007 and STN008) prepare three reports used for troubleshooting and evaluation of system effectiveness.

STN007 provides a list giving the number of retrievals for each keyword in each subscriber's profile (See Fig. 5), and a list giving the name of each subscriber, the number of documents referred per cycle, and a cumulative total of referrals (See Fig. 6).

#### ROUTINE IV: FILE UPDATING AND VALIDATION (See Fig. A-4)

These programs (STN0AA, STN0AB, and STN901) accept changes, additions, and deletions, and validate all profile keywords against a master tape of

authorized keywords.

STN0AA updates the user profiles and produces a printout of the current profile list of all subscribers (See Fig. 7).

STN0AB validates the entire profile keyword file by comparing each keyword with an authorized list of all DDC descriptors, and produces a list of all subscribers who use each keyword (See Fig. 8) and a punch card for all invalid descriptors for correction in the next cycle.

STN901 updates the master authority list of all DDC descriptors.

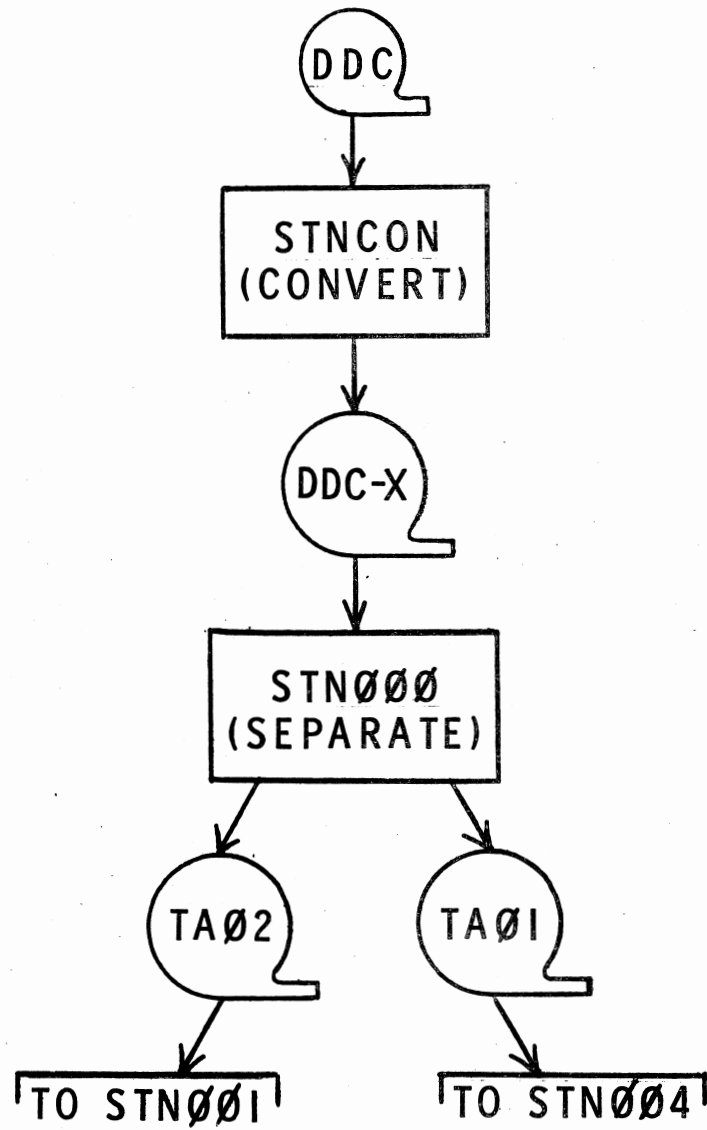


FIGURE A-1 TAPE CONVERSION

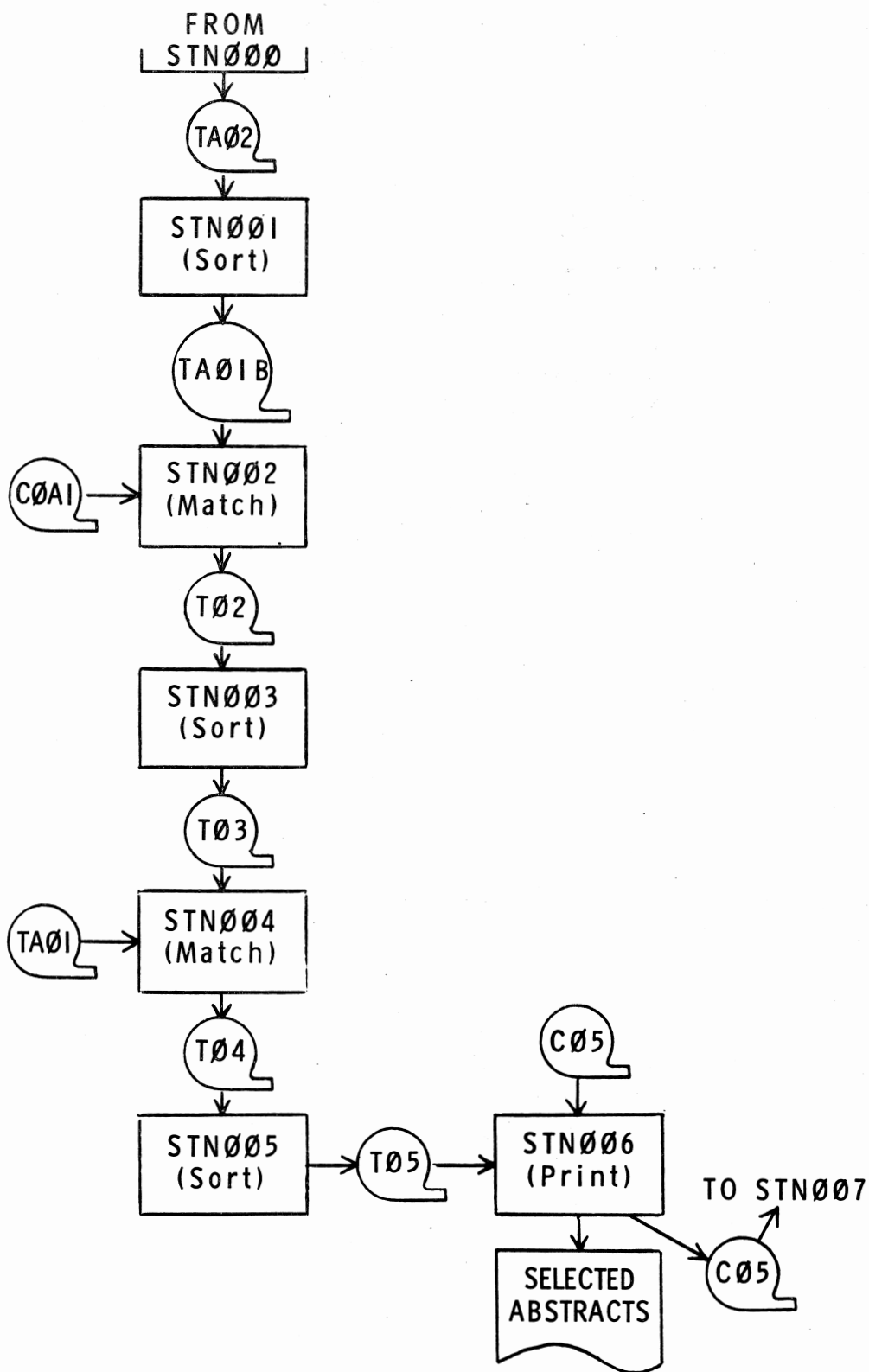


FIGURE A-2 SELECTION OF CITATIONS



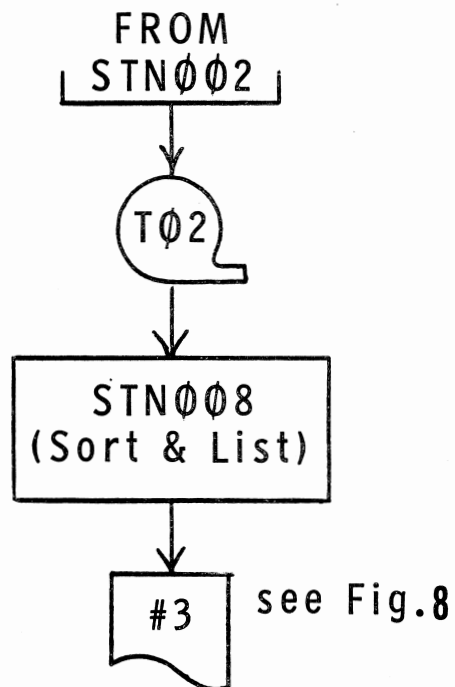
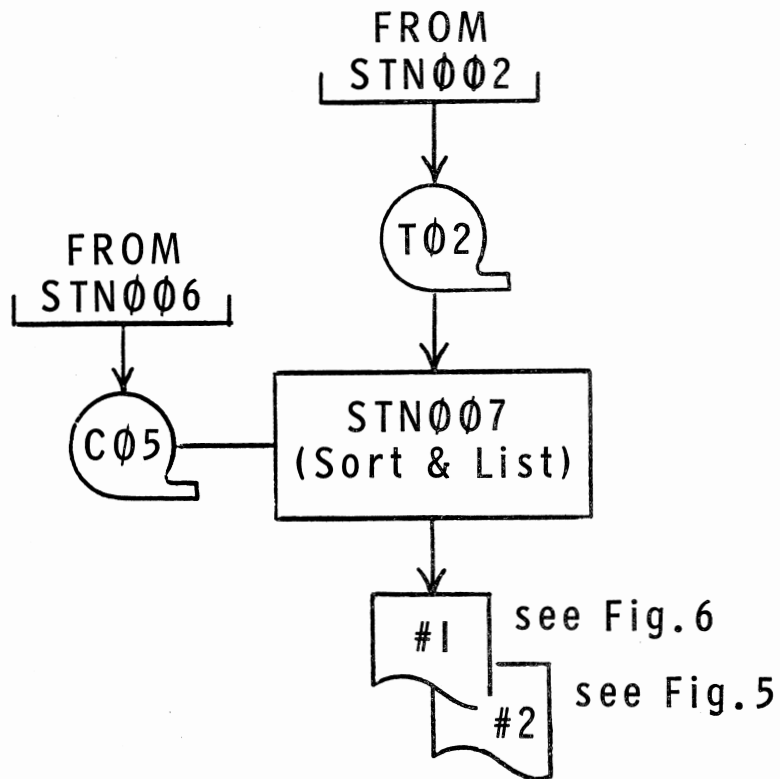


FIGURE A-3 STATISTICAL REPORTS

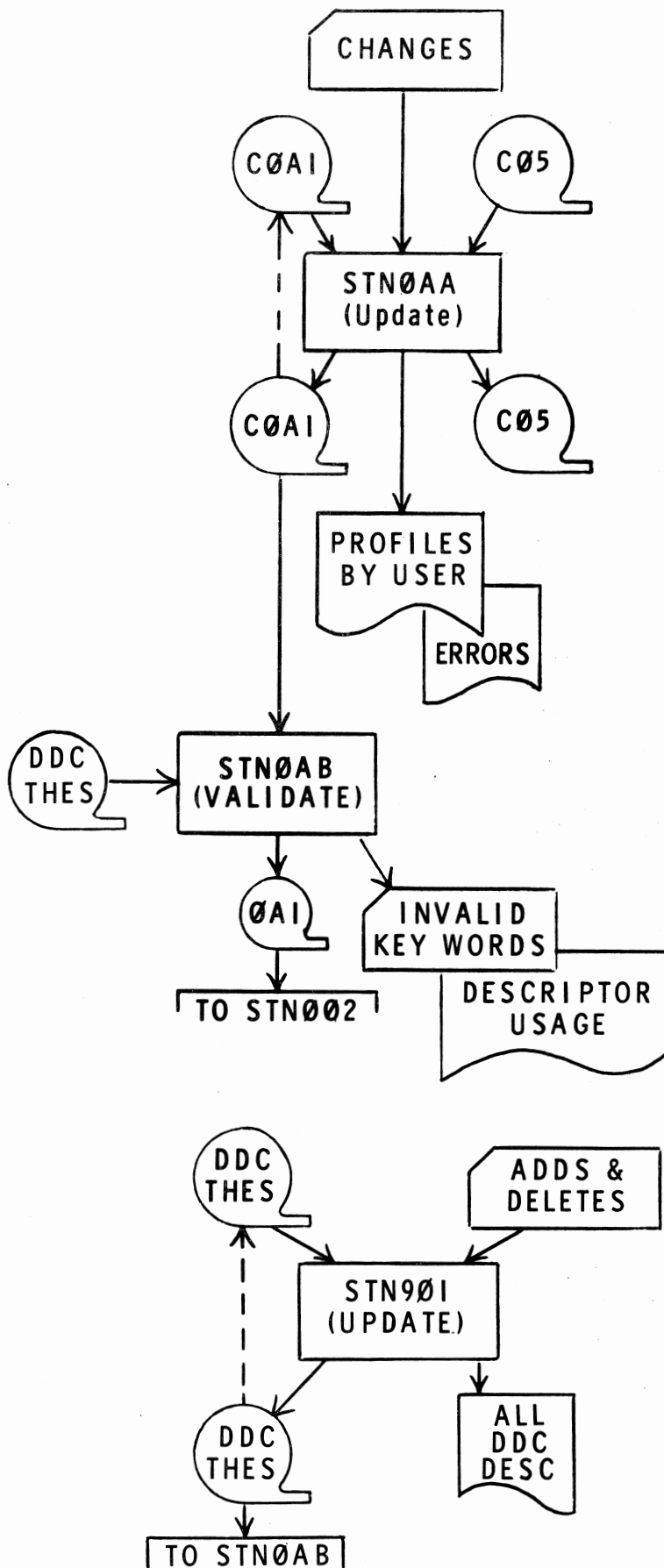


FIGURE A-4 FILE UPDATING & VALIDATION

## DOCUMENT CONTROL DATA - R&amp;D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

## 1. ORIGINATING ACTIVITY (Corporate author)

U. S. Army Electronics Command  
Fort Monmouth, New Jersey

## 2a. REPORT SECURITY CLASSIFICATION

Unclassified

## 2b. GROUP

## 3. REPORT TITLE

DEVELOPMENT AND EVALUATION OF A LARGE-SCALE SYSTEM FOR SELECTIVE DISSEMINATION  
OF INFORMATION (SDI)

## 4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

## 5. AUTHOR(S) (Last name, first name, initial)

D. W. Wixon  
E. M. Housman

## 6. REPORT DATE

August 1968

## 7a. TOTAL NO. OF PAGES

31

## 7b. NO. OF REFS

6

## 8a. CONTRACT OR GRANT NO.

## b. PROJECT NO.

c. N/A

d.

## 9a. ORIGINATOR'S REPORT NUMBER(S)

ECOM-3001

## 9b. OTHER REPORT NO(S). (Any other numbers that may be assigned this report)

## 10. AVAILABILITY/LIMITATION NOTICES

This document has been approved for public release and sale; its distribution is unlimited.

## 11. SUPPLEMENTARY NOTES

## 12. SPONSORING MILITARY ACTIVITY

U. S. Army Electronics Command  
ATTN: AMSEL-TD-TI  
Fort Monmouth, New Jersey 07703

## 13. ABSTRACT

This report describes a large-scale computerized system for Selective Dissemination of Information (SDI) developed over the past five years at the U. S. Army Electronics Command to serve its technical personnel. The system, which uses as its document base the current accessions of the Defense Documentation Center, was developed in three phases: an 18-month semiautomated test with 50 subscribers, a fully automated system with about 500 subscribers, and a proposed standard system for Army use. System descriptions include profiling techniques, keyword matching strategies, processing procedures, flow charts, and samples of inputs and outputs. System effectiveness is evaluated in terms of document ordering, relevance of citations, and the impact the system has had on the R&D program as revealed by responses to questionnaires.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
*Dissemination *Documentation *Information Retrieval Reports Subject Indexing Programming (Computers) Scientific Personnel Abstracts Libraries Defense Documentation Center SDI						

## INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (*corporate author*) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parentheses immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (*either by the originator or by the sponsor*), also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

- (1) "Qualified requesters may obtain copies of this report from DDC."
- (2) "Foreign announcement and dissemination of this report by DDC is not authorized."
- (3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through \_\_\_\_\_."
- (4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through \_\_\_\_\_."
- (5) "All distribution of this report is controlled. Qualified DDC users shall request through \_\_\_\_\_."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (*paying for*) the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.

ESC-FM- 3360-68